

A COMPARISON OF HONEY BEE (*Apis mellifera* L.) COLONIES ESTABLISHED FROM PACKAGES OR NUCLEI IN TWO AREAS OF BRITISH COLUMBIA, CANADA

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SUMMARY

A comparison of the biological performance and economic returns from honey bee colonies established in April from either 0.9 kg packages or four-frame nuclei was made in both the Lower Fraser Valley and Peace River areas of British Columbia. In the Lower Fraser Valley, nuclei were superior to packages both biologically and economically, while in the Peace River, no biological differences were found between the two, and packages provided higher economic returns. Either packages or nuclei would be viable in commercial beekeeping operations, depending on individual circumstances.

INTRODUCTION

A new honey bee (*Apis mellifera* L.) colony may be established in the spring from either a package or a nucleus. A package consists of 0.9-1.8 kg of bees (7,500-17,000 bees) plus a queen. The bees are transported in a wooden box covered on each side with wire screen to provide ventilation, with a metal can containing sugar syrup hung inside the box to feed the bees during transit. A nucleus consists of three to five frames of bees, brood, honey and pollen plus a queen, and is commonly transported in a cardboard box with a screened lid to allow for ventilation. Before the First World War, nuclei were widely used in the U.S. and Canada for establishing colonies. Fear of disease transmission reduced the demand, however, and the package bee business developed, so that packages purchased from shippers in the southern states replaced the nuclei used earlier (Johansson and Johansson 1970). Recently, a renewed interest in nuclei has been shown by beekeepers (Winston 1983). However, research on the comparative biological performance and economic returns to the purchaser from use of packages and nuclei is needed if nuclei are to be accepted commercially.

Nuclei are more expensive to purchase than packages; \$35.00 for a four-frame nucleus versus \$29.70 for a 0.9 kg package (McCutcheon 1984). In addition, nuclei must be inspected to ensure they are disease free, and standards for nuclei are not as precise as for packages. The bee population and brood, honey or pollen areas may vary greatly among producers of nuclei. However, nuclei have one principal advantage over packages. A nucleus contains drawn comb, stored honey and pollen, and, most importantly, brood, all of which should enhance early population growth. This may be a critical factor in regions with short growing seasons, as in most of Canada.

The objective of this research was to compare the biological performance and economic returns from 0.9 kg packages and four-frame nuclei established in April in both the Lower Fraser Valley and Peace River areas of B.C.

MATERIALS AND METHODS

A. Lower Fraser Valley

This study was conducted from April to August 1984 at a single apiary site in Langley, in the Lower Fraser Valley area of southwestern British Columbia. A total of 20 colonies were established on 17 April, each in a single super (drawn comb) of standard Langstroth equipment (497 mm x 420 mm x 241 mm deep). Ten colonies were established from 0.9 kg packages and 10 colonies from four-frame nuclei. All colonies were headed by Italian (*Apis mellifera ligustica* L.) queens imported from Florida.

Colonies were managed throughout the season for honey production using standard techniques. A second brood super and either one or two honey supers were added as required (standard Langstroth equipment). Sixteen and a half liters of sugar syrup were fed to all

colonies between 17 April and 26 May to facilitate colony growth. Oxytetracycline hydrochloride mixed in icing sugar also was fed to all colonies from 22 April to 12 July for brood disease prevention.

Five colony characteristics (sealed brood, honey and pollen areas, colony weight, and frames of bees) were measured approximately every 21 days from 10 May to 1 August. Sealed brood, honey and pollen areas were measured using a plexiglass grid to estimate the area on each frame. All colonies were weighed with a tripod scale. Colony weight was determined by subtracting the weight of empty equipment from the tripod scale reading. The number of frames of adult workers was estimated by looking through the super from above and below to determine how many frames were covered by workers. Extracted honey was determined in August by weighing supers before and after frames of honey were extracted. All colonies were left with six full frames of honey after the honey removal in August. For economic analyses, honey was valued at \$1.12 per kg, the average sale price of bulk honey in B.C. in 1984 (McCutcheon 1984). The purchase prices of 0.9 kg packages and four-frame nuclei were valued at \$29.70 and \$35.00 respectively (McCutcheon 1984).

Student's t-test was used to test for significant differences between experimental treatments ($P \leq 0.05$).

B. Peace River

On 17 April, 1984 ten 0.9 kg packages and ten four-frame nuclei were transported by truck to a 1500-colony commercial beekeeping operation in the Peace River region of British Columbia, and maintained throughout the season by the cooperating beekeeper, Dale Hansen. The packages and nuclei were established in a single super (drawn comb) of standard Langstroth equipment and managed throughout the season for honey production using standard techniques. All colonies were headed by Italian queens imported from Florida. Colonies were weighed twice during the season; 5 June and 3 July. Extracted honey was determined in August by weighing supers before and after frames of honey were extracted. The same figures listed in part A were used for economic analyses.

Student's t-test was used to test for significant differences between experimental treatments ($P \leq 0.05$).

RESULTS

A. Lower Fraser Valley

By 1 August the biological characteristics did not differ significantly between packages and nuclei ($P > 0.05$) except for colony weight, where the nuclei weighed significantly more than the packages ($P = 0.02$) (Fig. 1). Significant differences in biological characteristics occurred on various earlier measurement dates, with nuclei always recording higher measurements than packages. The nuclei produced significantly more honey than did the packages ($P = 0.03$) (Fig. 1). Both nuclei and packages recorded deficits of \$12.94 (Canadian) and \$18.28 (Canadian) respectively (Table I).

B. Peace River

Colony weight on both measurement dates and extracted honey did not differ significantly between packages and nuclei ($P > 0.05$) (Fig. 2 and 3). Packages provided higher incomes than nuclei, \$57.77 (Canadian) and \$52.36 (Canadian) respectively (Table II).

DISCUSSION

The results of this study suggest that both packages and nuclei are commercially viable in B.C., and which is used will depend on area and compatibility with an individual's beekeeping operation. By 1 August the packages and nuclei in the Lower Fraser Valley differed significantly only in colony weight and extracted honey (Fig. 1). The packages produced significantly less extracted honey than the nuclei, possibly due to a smaller foraging force during the nectar flow. In the Langley area the major nectar flow is in July (McCutcheon 1982); on 20 June (approximately one week before the beginning of the nectar flow) and 12 July (during the nectar flow) the packages had a significantly smaller worker population than

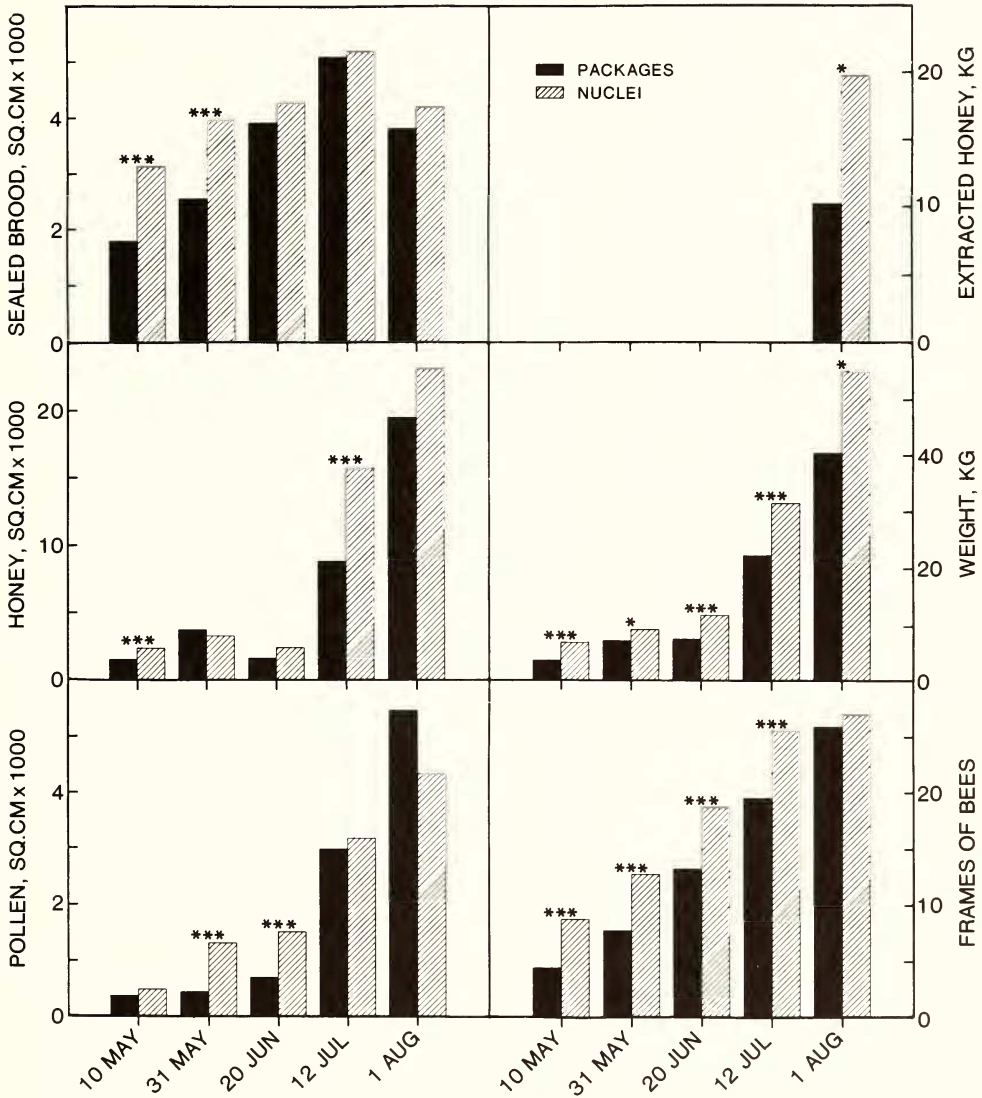


Figure 1: Biological (sealed brood, honey and pollen areas, frames of bees and colony weight) and economic (extracted honey) characteristics on five measurement dates for colonies established from 0.9 kg packages and four-frame nuclei in the Lower Fraser Valley. Standard errors are represented by bars above each histogram. (*= $P \leq 0.05$, **= $P \leq 0.01$, ***= $P \leq 0.005$).

TABLE I

Incomes from colonies established from 0.9 kg packages and four-frame nuclei in the Fraser Valley.

| Treatment | Purchase Price (\$) | Extracted Honey (kg) | Honey Income (\$) | Total Income (\$) |
|-----------|---------------------|----------------------|-------------------|-------------------|
| Package | 29.70 | 10.2 | 11.42 | -18.28 |
| Nucleus | 35.00 | 19.7 | 22.06 | -12.94 |

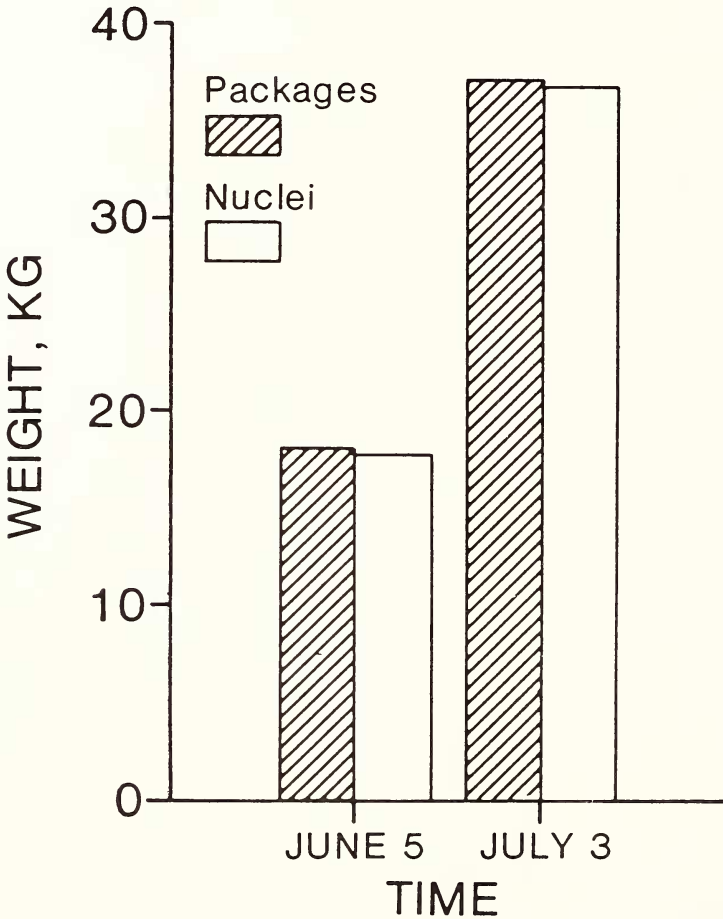


Figure 2: Colony weight on two measurement dates for colonies established from 0.9 kg packages and four-frame nuclei in the Peace River. ($P > 0.05$ on both dates).

the nuclei, but both treatments were maintaining equivalent brood areas (Fig. 1). This meant that the packages had a greater proportion of their worker population involved in brood rearing, resulting in a smaller foraging force. Previous research has reported the tendency of small colonies to allocate a high proportion of available resources to brood rearing, resulting in low honey production (Farrar 1968). The worker population in colonies started from packages peaked after the nectar flow (1 August) (Fig. 1), resulting in a significantly lower honey yield than the nuclei.

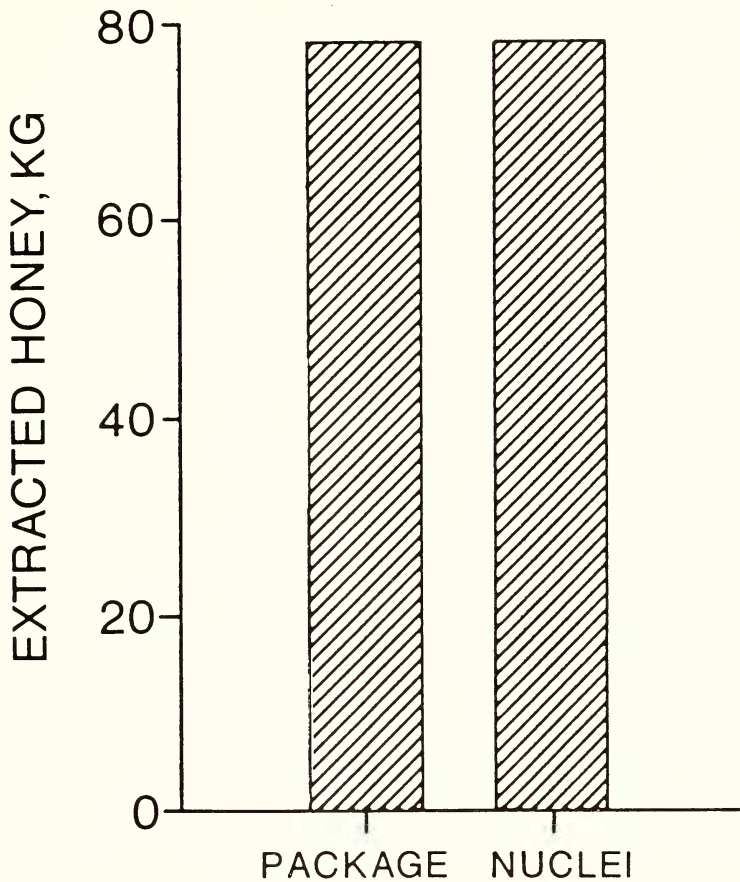


Figure 3: Extracted honey for colonies established from 0.9 kg packages and four-frame nuclei in the Peace River. ($P > 0.05$).

TABLE II

Incomes from colonies established from 0.9 kg packages and four-frame nuclei in the Peace River.

| Treatment | Purchase Price (\$) | Extracted Honey (kg) | Honey Income (\$) | Total Income (\$) |
|-----------|---------------------|----------------------|-------------------|-------------------|
| Package | 29.70 | 78.1 | 87.47 | 57.77 |
| Nucleus | 35.00 | 78.0 | 87.36 | 52.36 |

The packages and nuclei in the Peace River were not monitored as closely as those in the Lower Fraser Valley. The colonies in the Peace River had only colony weight measured on two dates, and extracted honey determined at the end of the season. Packages and nuclei in the Peace River produced equivalent amounts of extracted honey (Fig. 3), whereas in the Lower Fraser Valley, nuclei produced significantly more extracted honey than packages (Fig. 1). This difference was probably due to the later honey flow in the Peace River, which begins in mid-July, two weeks later than in the Lower Fraser Valley. This allows packages to "catch up" to nuclei before the honey flow, thereby producing equivalent amounts of extracted honey. In the

Lower Fraser Valley, the honey flow began before the packages were as populous as the nuclei, and they did not produce as much extracted honey. The suitability of packages and nuclei for honey production would appear to be at least partially dependent on the timing of the honeyflow in an area. Had 1983 been a severe spring rather than mild in the Peace River, the nuclei may have performed better than the packages due to their initial advantage of brood and a slightly larger worker population (D. Hansen, personal communication).

Economically, the results from the Lower Fraser Valley and the Peace River also differed. In the Lower Fraser Valley, neither nuclei or packages provided an income (Table I), whereas both packages and nuclei provided incomes in the Peace River (Table II). In the Lower Fraser Valley in 1984, a relatively poor year, nuclei and packages produced deficits of \$12.94 and \$18.28 respectively. In seasons with both a good nectar flow and good weather, both nuclei and packages may provide an income in the Lower Fraser Valley. Under such conditions nuclei would likely provide the greater income, since they have a larger foraging force available during the early honeyflow characteristic of the Lower Fraser Valley. In the Peace River, both packages and nuclei yielded incomes, but packages provided a higher income (\$57.77) than nuclei (\$52.36) due to their lower purchase price (Table II).

The beekeeping operation in the Peace River to which the packages and nuclei were sent has traditionally been based on spring package management. The cooperating beekeeper found the nuclei more labor-intensive from the standpoint of transportation and installation (D. Hansen, personal communication), partly because his operation was set up to accommodate packages, not nuclei. In the Lower Fraser Valley study no difference was noted in ease of transportation of packages and nuclei, and the nuclei were considered to be easier to install than the packages.

Numerous researchers have made biological and economic comparisons between packages of different sizes established on different dates (reviewed in Nelson and Jay 1972). However, comparisons between packages and nuclei have been lacking. To our knowledge, this experiment represents the only comparison made between packages and nuclei. If Canadian beekeepers are to become self-sufficient, both packages and nuclei will have to be incorporated into beekeeping operations. This preliminary research indicates that either packages or nuclei would be viable in commercial beekeeping operations, depending on individual circumstances. In the Lower Fraser Valley nuclei are superior to packages both biologically and economically, while in the Peace River, no biological differences were found between the two, and packages provided greater economic returns than nuclei. However, research for more than one season and in various beekeeping areas of the province is needed to establish the suitability of packages versus nuclei for honey production.

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